UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/782,821	02/23/2004	Hiroki Futatsuya	040065	5438

23850 7590 03/07/2007

ARMSTRONG, KRATZ, QUINTOS, HANSON & BROOKS, LLP
1725 K STREET, NW
SUITE 1000
WASHINGTON, DC 20006

EXAMINER	
GUILL, RUSSELL L	
ART UNIT	PAPER NUMBER
2123	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	03/07/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/782,821	FUTATSUYA ET AL.	
	Examiner	Art Unit	
	Russ Guill	2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 February 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *2/23/2004*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1 - 12 have been examined. Claims 1 - 12 have been rejected.

Claim Rejections - 35 USC § 101

2. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. Claims 1 - 12 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

a. Regarding claims 1 - 5, the recited method appears to contain abstract ideas such as calculating an average value of light. Therefore, to be statutory, the claim must be directed to a practical application producing a concrete, useful and tangible result. The claim does not appear to produce a tangible result needed to support a practical application.

b. Regarding claims 6 - 10, the recited equipment appears to perform abstract operations, such as calculating average light intensity. Therefore, to be statutory, the claim must be directed to a practical application producing a concrete, useful and tangible result. The claims do not appear to produce a tangible result needed to support a practical application.

c. Regarding claim 11, the recited computer program appears to perform abstract operations such as calculating an average value of light. Therefore, to be statutory, the claim must be directed to a practical application producing a concrete, useful and tangible result. The claim does not appear to produce a tangible result needed to support a practical application.

d. Regarding claim 11, the claim is directed to a computer readable storage medium on which a computer program is stored. Under a broad reasonable interpretation, the computer program may be interpreted as source code, which is non-functional material *per se*, and therefore is non-statutory.

e. Regarding claim 11, the claim is directed to a computer readable storage medium on which a computer program is stored. The specification appears to allow the interpretation of a computer readable storage medium as including various transmission media such as a wire circuit, an optical fiber, a wireless circuit, a LAN or the Internet. These elements do not allow the computer program to act as a computer component and allow the functionality of the computer program to be realized, and therefore, no usefulness of the computer program can be realized. Therefore, the claims are non-statutory.

f. Regarding claim 12, the recited computer program product appears to perform abstract operations such as calculating an average value of light. Therefore, to be statutory, the claim must be directed to a practical application producing a concrete, useful and tangible result. The claim does not appear to produce a tangible result needed to support a practical application.

g. Regarding claim 12, the claim is directed to a computer product. Under a broad reasonable interpretation, the computer product may be interpreted as source code, which is non-functional material *per se*, and therefore is non-statutory.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. **Claims 1 - 2, 5 - 7 and 10 - 12** are rejected under 35 U.S.C. 103(a) as being unpatentable over Takahashi (Kimitoshi Takahashi et al.; "Proximity effect correction using pattern shape modification and area density map", 2000, Journal of Vacuum Science and Technology B, Volume 18, Number 6, pages 3150 - 3157) in view of LaFontaine (Bruno La Fontaine et al.; "Analysis of Flare and its Impact on Low-k1 KrF and ArF Lithography", 2002, Proceedings of the SPIE, Volume 4691, pages 44 - 56).

a. The art of Takahashi is directed to proximity effect correction by modifying the shape of a pattern of exposure (*page 3150, Title and Abstract*), including using a point spread function with a discrete approximation to calculate lithographic blurring effects (*pages 3153 – 3154*).

b. The art of LaFontaine is directed to analysis of flare (lithographic blurring) using a point spread function (*page 44, Abstract; and pages 45 – 46, section 2. Brief theoretical background*).

c. The art of Takahashi and the art of LaFontaine are analogous art because they both pertain to the use of a point spread function to calculate lithographic blurring effects, and both pertain to semiconductor lithography.

d. Regarding **claims 1, 6, 11 and 12**:

e. Takahashi appears to teach:

i. dividing a layout of a photo mask into a plurality of areas (*page 3135, figure 7*),

ii. calculating an average value of beam intensity in each of the areas (*page 3153, figure 7*), and

f. Takahashi does not specifically teach:

i. calculating an average value of **light** intensity in each of the areas

ii. estimating the amount of occurrence of local flare in each of the areas on the basis of each of the average values.

g. LaFontaine appears to teach:

i. calculating **light** intensity in each of a plurality of areas (*pages 45 – 46, section 2. Brief theoretical background, and figure 1; the recited section appears to teach using a convolution of a point spread function with a light intensity to calculate flare. The ordinary artisan would have known that a point spread function was convolved with an intensity function because it was the basis of the Hopkins model for image formation as described in the reference by Y. C. Pati et al., "Exploiting Structure in Fast Aerial Image Computation for Integrated Circuit Patterns, pages 62 – 63, section II. The Image Formation Model. Further, the ordinary artisan would have known that in order to perform a numerical calculation, a continuous convolution must be approximated and performed on discrete areas, and the intensity in the area would have been calculated as the exposed area in a discrete area*).

ii. estimating the amount of occurrence of local flare in each of the areas on the basis of each of the average values (*pages 45 – 46, section 2. Brief theoretical background; the recited section appears to teach using a convolution of a point spread function with a light intensity to calculate flare. The ordinary artisan would have known that in order to perform the convolution, the point spread function would have been convolved with the light intensity calculated in the preceding limitation*).

h. The ordinary artisan would have known to use the area density map method in Takahashi because of the success in using the method recited in the reference by Teruyoshi Yao, "Local Flare Effects and Correction in ArF Lithography".

i. The motivation to use the art of LaFontaine with the art of Takahashi would have been the benefits recited in LaFontaine that the results are used to predict the performance of scanners, and the importance of flare on image control and process latitude is demonstrated (*page 45, second paragraph*), which would have been recognized as a benefit by the ordinary artisan to improve the lithographic process and thereby reduce time and cost.

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of LaFontaine with the art of Takahashi to produce the claimed invention.

k. Regarding **claims 2 and 7**:

l. Takahashi appears to teach:

i. each of the average values is subjected to smoothing processing (*page 3153, figure 7*), a smoothed average value is multiplied by a first multiplier, and an obtained value is evaluated as the amount of occurrence of local flare in each of the areas (*pages 3153 – 3154, section A. Area density map method, especially the part on page 3154, and figure 7*).

m. Regarding **claims 5 and 10**:

n. Takahashi does not specifically teach:

i. each of the values evaluated as the amount of occurrence of local flare is used in optical proximity correction.

o. LaFontaine appears to teach:

i. each of the values evaluated as the amount of occurrence of local flare is used in optical proximity correction (*page 44, section 1. Introduction, first paragraph, last sentence, especially "predict the performance of OPC", OPC is Optical Proximity Correction*).

7. **Claims 3 and 8** is rejected under 35 U.S.C. 103(a) as being unpatentable over Takahashi as modified by LaFontaine as applied to claims **1 - 2, 5 - 7 and 10 - 12** above, further in view of Erdmann (Andreas Erdmann et al.; "Enhancements in Rigorous Simulation of Light Diffraction from Phase Shift Masks", 2002, Proceedings of SPIE, Volume 4691, pages 1156 - 1167).

a. Takahashi as modified by LaFontaine teaches a method for simulating local flare which occurs in an exposure process in manufacturing a semiconductor device, as recited in claims **1 - 2, 5 - 7 and 10 - 12** above.

b. The art of Erdmann is directed to simulation of light diffraction from phase shift masks (*page 1156, Title*).

c. The art of Erdmann and the art of Takahashi as modified by LaFontaine are analogous art because they are all pertain to the art of lithography (*Erdmann, page 1156, Abstract; Takahashi, page 3150, Introduction; LaFontaine, page 44, Introduction*).

d. Regarding **claims 3 and 8**:

e. Takahashi appears to teach:

i. when the average value of light intensity in each of the areas is calculated, the average value is calculated by multiplying the light intensity of the diffracted light passing through a projection lens by a second multiplier (*pages 3153 – 3154, section A. Area density map method, and figure 7*).

f. Takahashi does not specifically teach (in **bold underline**):

i. when the average value of light intensity in each of the areas is calculated, **diffracted light is calculated by a Fourier transformed image of each of the areas of the layout**, and the average value is calculated by multiplying the light intensity of the diffracted light passing through a projection lens by a second multiplier.

g. Erdmann appears to teach:

i. diffracted light is calculated by a Fourier transformed image of each of the areas of the layout (*page 1158, second paragraph, sentence that starts, "The diffraction spectrum . .", and page 1162, section 2.3 Projection Optics*).

h. The motivation to use the art of Erdmann with the art of Takahashi as modified by LaFontaine would have been the benefit recited in Erdmann that the paper reviews new model developments which are used for fast rigorous simulation of light diffraction from a phase shift mask (page 1156, section Introduction, fourth paragraph that starts with, "We will start . . ."), which would have been recognized by the ordinary artisan as a benefit because of the reduced time to calculate results.

i. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Erdmann with the art of Takahashi as modified by LaFontaine to produce the claimed invention.

8. **Claims 4 and 9** is rejected under 35 U.S.C. 103(a) as being unpatentable over Takahashi as modified by LaFontaine as applied to claims **1 - 2, 5 - 7 and 10 - 12** above, further in view of Mack (Chris A. Mack; "Measuring and Modeling Flare in Optical Lithography", June 2003, Optical Microlithography XVI, Proceedings of the SPIE, Volume 5040, pp. 151-161).

a. Takahashi as modified by LaFontaine teaches a method for simulating local flare which occurs in an exposure process in manufacturing a semiconductor device, as recited in claims **1 - 2, 5 - 7 and 10 - 12** above.

b. The art of Mack is directed to simulation of light diffraction from phase shift masks (*page 1156, Title*).

c. The art of Mack and the art of Takahashi as modified by LaFontaine are analogous art because they are all pertain to the art of lithography (*Mack, page*

151, Title and Keywords; Takahashi, page 3150, Introduction; LaFontaine, page 44, Introduction).

d. Regarding **claims 4 and 9**:

e. Takahashi does not specifically teach:

i. each of the values evaluated as the amount of occurrence of local flare is added to the light intensity in order to simulate an optical image.

f. Mack appears to teach:

i. each of the values evaluated as the amount of occurrence of local flare is added to the light intensity in order to simulate an optical image (*page 159, section III. Modeling Flare, equation (1)*).

g. The motivation to use the art of Mack with the art of Takahashi as modified by LaFontaine would have been the benefit recited in Mack that a new model is described for flare that improves upon existing models (*page 151, Abstract, last sentence*), which would have been recognized as a benefit by the ordinary artisan since an improved model allows for more accurate calculations that reduce errors and reduce expenses.

h. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Mack with the art of Takahashi as modified by LaFontaine to produce the claimed invention.

9. **Examiner's Note:** Examiner has cited particular columns and line numbers in the references applied to the claims above for the convenience of the applicant. Although the specified citations are representative of the teachings of the art and are applied to specific limitations within the individual claim, other passages and figures may apply as well. It is respectfully requested from the Applicant in preparing responses, to fully consider the references in their entirety as potentially teaching all or part of the claimed

invention, as well as the context of the passage as taught by the prior art or disclosed by the Examiner. The entire reference is considered to provide disclosure relating to the claimed invention.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to the applicant's disclosure:

a. Teruyoshi Yao et al.; "Local Flare Effects and Correction in ArF Lithography", June 2003, 2003 Symposium on VLSI Technology Digest of Technical Papers, pages 43 - 44; teaches using the area density map method to speed up local flare effects calculations.

b. Y. C. Pati et al.; "Exploiting Structure in Fast Aerial Image Computation for Integrated Circuit Patterns", 1997, IEEE Transactions on Semiconductor Manufacturing, Volume 10, Number 1, pages 62 - 74; teaches the Hopkins model for calculating an intensity using convolution.

c. Yoda (U.S. Patent Number 5,278,421) teaches calculating the exposure area of a partial region as a sum of the exposure areas in the partial region, and smoothing the result (columns 7 - 8).

d. Medvedeva (U.S. Patent Number 6,171,731) teaches the Hopkins model.

e. Fumio Murai et al.; "Fast proximity effect correction method using a pattern area density map", 1992, Journal of Vacuum Science and Technology B, Volume 10, Number 6, pages 3072 - 3076; teaches the pattern area density method.

f. Joseph P. Kirk; "Scattered light in photolithographic lenses", 1994, Proceedings of SPIE, Volume 2197, pages 566 - 572; teaches a flare scattering model.

g. Morimi Osawa et al.; "Correction for local flare effects approximated with double Gaussian profile in ArF lithography", December 2003, Journal of Vacuum Science and Technology B, Volume 21, Number 6, pages 2806 - 2809; while not prior art, the reference teaches the claim limitations.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Russ Guill whose telephone number is 571-272-7955. The examiner can normally be reached on Monday - Friday 9:30 AM - 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Rodriguez can be reached on 571-272-3753. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300. Any inquiry of a general nature or relating to the status of this application should be directed to the TC2100 Group Receptionist: 571-272-2100.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Russ Guill
Examiner
Art Unit 2123

RG

PAUL RODRIGUEZ
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100

3/2/07